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Patent claims

1. A power supply device having several switch-mode power supplies connected in parallel to supply at least one load (32), each switch-mode power supply generating an output current I_0 and an output voltage $U_0(I_0, R_L)$ that is a function of the output current I_0 and a load resistance R_L, and having a control device for each switch-mode power supply, c h a r a c t e r i z e d in that the control device

   has a first stage (50) having a P element (54) that receives a P element input voltage which is derived from the output voltage $U_0(I_0, R_L)$, and generates a P element control voltage U_{VS}, that is used to control the respective switch-mode power supply, the first stage being active when $0 \leq I_0 \leq I_{0P}$,

   a second stage (60) having a current imaging circuit which reproduces the output current I_0 of the respective switch-mode power supply and generates an output current control voltage U_P which is used to control the respective switch-mode power supply, the second stage being active when $I_{0P} \leq I_0 \leq I_{0S}$, and

   a third stage (70) having an amplifier circuit (74) which amplifies a signal proportional to the output current I_0 and generates an amplified output current control voltage $m \cdot U_S$ which is used to control the respective switch-mode power supply, the third stage being active when $I_{0S} \leq I_0 \leq I_K$.

2. A power supply device according to claim 1, c h a r a c t e r i z e d in that the second stage is also active when $I_{0S} \leq I_0$.

3. A power supply device according to claim 1 or 2, c h a r a c t e r i z e d in that I_{0P} is a first threshold value of the output current I_0 which characterizes the limit of a normal operating range; I_{0S} is a second threshold value of the output current I_0 which characterizes the limit of an operating range with a heavier load; and I_K characterizes a short circuit current limitation.

4. A power supply device according to one of the above claims, c h a r a c t e r i z e d in that the control device has a pulse width modulation circuit (80) which receives the P element control voltage U_{VS}, the output current control voltage U_P and the amplified output current control voltage U_S and generates a control signal U_T for the respective switch-mode power supply in response thereto.

5. A power supply device according to one of the above claims, c h a r a c t e r i z e d in that the first stage (50) has a voltage divider (51, 52, 53) that generates a P element input voltage proportional to the output voltage U_0.

6. A power supply device according to claim 5, c h a r a c t e r i z e d in that the P element (54) of the first stage (50) has an operational amplifier, one of whose inputs receives the P element input voltage and whose other input receives a first reference voltage U_{REF1} and whose output emits the P element control voltage U_{VS}.

7. A power supply device according to claim 4 and 6, c h a r a c t e r i z e d in that the operational amplifier (54) is connected to the pulse width modulation circuit (80) via a blocking diode (36).

8. A power supply device according to one of the above claims, c h a r a c t e r i z e d in that the second stage (60) has a transformer element (62) that is connected in parallel to the main transformer element (26) of the respective switch-mode power supply and generates an output signal that is proportional to the output current I_0 of the switch-mode power supply.

9. A power supply device according to claim 8, c h a r a c t e r i z e d in that downstream from the transformer element (62), a zener diode (63) and an RC circuit (64, 65) are connected which generate the output current control voltage U_P as a function of the transformer output signal when $I_0 \geq I_{0P}$, U_P being proportional to I_0.

10. A power supply device according to one of the above claims, c h a r a c t e r i z e d in that the third stage (70) is connected downstream from the second stage (60) and the output

current control voltage U_P, which is proportional to the output current I_0 of the switch-mode power supply, forms the input signal of the third stage (70).

11. A power supply device according to one of the claims 1 to 9, c h a r a c t e r i z e d in that the third stage (70) is connected in parallel to the second stage (60) and has a further current imaging circuit which reproduces the output current I_0 of the switch-mode power supply.

12. A power supply device according to claim 10 or 11, c h a r a c t e r i z e d in that the third stage (70) has an amplifier circuit (74) one of whose inputs is connected to the current imaging circuit via a further RC circuit (72, 73) and whose other input is connected to the reference voltage U_{REF3} and whose output emits the amplified output current control voltage mUs.

13. A power supply device according to claim 12, c h a r a c t e r i z e d in that the amplifier circuit (74) of the third stage (70) is designed in such a way that it has a high amplification factor $m >> 1$,.